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**APPARATUS AND METHOD FOR PROCESSING  
SIGNALS SELECTED FROM MULTIPLE DATA STREAMS**

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1                   **APPARATUS AND METHOD FOR PROCESSING SIGNALS**  
2                   **SELECTED FROM MULTIPLE DATA STREAMS**

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5                   **TECHNICAL FIELD OF THE INVENTION**

6                   This invention relates to digital data transmission and more particularly to an apparatus  
7 and method for selecting from multiple data streams to produce a single data output.

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9                   **BACKGROUND OF THE INVENTION**

10                  Various types of information may be converted to a digital format and the digital data  
11 then transmitted to a user location as a radio frequency signal comprising a digital data stream.  
12 A single user location may be able to receive these digital radio frequency transmissions from  
13 multiple sources. For example, a user may receive signals directed from one or more terrestrial  
14 transmitters. Also, the same user may be able to receive digital radio frequency signals from  
15 one or more satellites. Regardless of the source of the radio frequency signals which comprise  
16 the digital data stream, each data stream must be processed at the user location to provide useful  
17 information.

18                  Direct broadcast satellite (DBS) television transmission is one example of digital radio  
19 frequency transmission. In DBS transmission, digital signals on a number of different carrier  
20 frequencies are transmitted from a satellite and these multiple carrier frequencies together  
21 comprise a data stream. The frequency spectrum now allotted to DBS transmissions comprises  
22 the spectrum from 12.2 to 12.7 GHz. Each carrier frequency carries data for several different  
23 discrete outputs, which in the DBS example, comprise television channels. In order to use the  
24 DBS data stream, the entire data stream is picked up by a suitable antenna and the frequencies

1 are down converted to an intermediate frequency below the radio frequency level. A receiver  
2 at the user location demodulates the desired carrier frequency and decodes the demodulated  
3 signals to produce a desired output comprising a channel input for a television set.  
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#### 5 SUMMARY OF THE INVENTION

6 It is an object of the invention to provide an apparatus and method for selecting from  
7 multiple data streams transmitted on one or more common frequencies and processing the  
8 selected data stream.

9 In order to accomplish this object, an apparatus according to the invention includes a  
10 plurality of signal input paths to a single receiver/signal processor. A switching arrangement  
11 associated with the signal input paths enables only one of the paths at a given time for  
12 communicating a data stream to the receiver/signal processor. Each signal input path may  
13 receive a separate data stream including signals at one or more frequencies which may or may  
14 not be common to frequencies for signals received on another one of the input paths. By  
15 enabling only one input path at a time, the switching arrangement prevents common frequency  
16 signals from interfering with each other. Furthermore all of the signals from each source may  
17 be processed by the single receiver/signal processor, thus avoiding duplicate signal processing  
18 equipment at the user location.

19 As used in this disclosure, the term "data stream" means digital data transmissions on one  
20 or more frequencies from a single source. The frequency or frequencies may be any frequency  
21 including radio frequencies and lower frequencies. For example, a data stream may comprise  
22 signals transmitted at radio frequencies from a satellite and may also comprise the same signals

1 after down conversion to intermediate frequencies. Also, as used herein "data" shall mean any  
2 digital data and shall not be limited to data producing any particular type of output. For  
3 example, "data" may comprise the digital signals required to produce a television input for a  
4 standard television set. As another example, "data" may comprise digital signals representing  
5 Internet communications. As yet another example, "data" may comprise digital voice or  
6 telephone information.

7 The switching arrangement includes a suitable switching device connected in each input  
8 path. Each switching device is enabled for passing the data stream only in response to an enable  
9 signal supplied to the respective switching device. In the absence of an enable signal the  
10 respective switching device serves to block the data stream on the particular input path. The  
11 plurality of the input paths meet at a junction having a single output which is connected to the  
12 input of the receiver/signal processor. The receiver/signal processor receives signals from the  
13 single enabled input path and processes the signals in a manner well known in the art to produce  
14 a desired data output.

15 The apparatus according to the invention has associated with it a separate radio frequency  
16 receiving arrangement for each signal input path. Each radio frequency receiving arrangement  
17 includes a suitable antenna for receiving signals from a single transmission source. Each radio  
18 frequency receiving arrangement further includes a suitable down converter for converting the  
19 radio frequency signals to intermediate frequency signals. Each separate data stream of  
20 intermediate frequency signals is applied to a different one of the signal input paths to the  
21 processing apparatus according to the invention.

1 In the preferred form of the invention, the processing apparatus includes a controller for  
2 controlling the switching arrangement and the various components of the receiver/signal  
3 processor. The controller responds to a user entered select input which is associated with certain  
4 data within one of the input data streams which may be processed to produce a desired data  
5 output. In response to a select input, the controller retrieves from a memory device signal input  
6 information for controlling the switching arrangement and signal processing information for  
7 controlling the receiver/signal processor. The controller uses the signal input information to  
8 enable the signal input path which carries the data stream containing the data for the selected  
9 output. The signal processing information causes the receiver/signal processor to tune to the  
10 correct carrier frequency carrying the desired data, demodulate transmitted signals, and finally  
11 decode the demodulated signals to produce the desired data output.

12 These and other objects, advantages, and features of the invention will be apparent from  
13 the following description of the preferred embodiments, considered along with the accompanying  
14 drawing.

#### 15 BRIEF DESCRIPTION OF THE DRAWING

16 Figure 1 is a diagrammatic representation of a multiple data stream processing apparatus  
17 embodying the principles of the invention.  
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## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figure 1, a multiple data stream processing apparatus 10 according to the invention receives one data stream on a first input path 11 and a separate and distinct data stream on a second input path 12. The apparatus 10 includes a receiver/signal processor 14 for receiving one of the two data streams and processing the data stream to produce a desired channel output from the received signals. A switching arrangement 16 allows only one data stream at a time to reach receiver/signal processor 14.

The apparatus 10 is located at a user location which may be any location which may receive data streams from multiple signal sources. The data streams comprise digital data transmitted from a signal source at suitable radio frequencies. Each data stream includes at least one carrier frequency and preferably several carrier frequencies. Each carrier frequency carries data which may be processed to produce at least one channel output. In most cases a single carrier frequency will carry data which may be processed to produce several different channel outputs. The term "channel output" is used in this disclosure for convenience to describe related data which may be used <sup>from that device</sup> to produce a desired output. For example, the channel output may be a signal suitable for use by a television. However, the invention is not limited to use with data streams comprising signals for producing a television input.

In the illustrated example of the invention, signals from one radio frequency transmitter (not shown) are received at a first antenna 21. The signals comprising the transmitted data stream may be in any radio frequency range. For example, the radio frequency transmissions received by the first antenna may be in the range from 12.2 to 12.7 GHz, the frequency band currently allotted for DBS television transmissions. The radio frequency signals received at first

1 antenna 21 are directed to a low noise block converter or LNB 23 where the signals are down  
2 converted to an intermediate frequency. The data stream at the intermediate frequency band is  
3 directed to the first input path 11 of processing apparatus 10. The intermediate frequency band  
4 may, for example, be approximately 950 to 1450 MHz. It is possible that the intermediate  
5 frequency could be within another frequency range, however this 950 to 1450 MHz range is  
6 useful for purposes of illustration because it corresponds to an intermediate frequency range  
7 produced from DBS signals transmitted at between 12.2 and 12.7 GHz.

8 Signals from a second radio frequency source (not shown) are received at a second  
9 antenna 22 and down converted by a second low noise block converter or LNB 24. LNB 24  
10 converts the radio frequency signals to intermediate frequency signals and directs the  
11 intermediate frequency data stream to the second input path 12 of processing apparatus 10.

12 The invention is not limited to signals received from a particular type of signal source.  
13 For example, one source may be a satellite while the other radio frequency signal source may  
14 be a terrestrial transmitter. Alternatively, both radio frequency signal sources may be satellites  
15 or both may be terrestrial transmitters. In any case, the radio frequency signals received by first  
16 antenna 21 and second antenna 22 may include signals at the same carrier frequencies. Although  
17 in some cases the carrier frequencies received by the two radio frequency receiving antennae 21  
18 and 22 may be identical, in other applications of the invention the two distinct sets of signals  
19 may include only a few of the same carrier frequencies or none of the same carrier frequencies  
20 and each set may include other carrier frequencies which are not included in the other set.  
21 Where the radio frequency transmissions received at the antennae 21 and 22 share at least one  
22 common frequency, the signals cannot all be combined on a single propagation path without

1 interference. For example, the first antenna 21 may receive signals at a transmission frequency  
2 of 12.2 GHz. The second antenna 22 may receive signals transmitted at the same 12.2 GHz  
3 frequency but carrying entirely different data. In this case, if the signals from the two antennae  
4 21 and 22 were combined on a common signal path, the common frequency signals would  
5 interfere with each other.

6 The two signal input paths 11 and 12 pass through switching arrangement 16. Switching  
7 arrangement 16 includes a first on/off amplifier or switch 31 connected in the first input path  
8 11, and a second on/off amplifier or switch 32 connected in the second input path 12. First  
9 on/off amplifier 31 is connected to receive an enable signal through a first enable line 33 while  
10 second on/off amplifier 32 is connected to receive an enable signal applied on a second enable  
11 line 34. The output of first on/off amplifier 31 and the output of second on/off amplifier 32 are  
12 applied as inputs to a junction amplifier 36. Junction amplifier 36 produces a single junction  
13 output at output line 37. Elements 31 and 32 may comprise any suitable on/off amplifier or  
14 active switch while the junction amplifier 36 may comprise any suitable summing amplifier.

15 On/off amplifier 31 operates to pass the intermediate frequency signals or data stream  
16 received on input path 11 only when an enable signal is applied to the amplifier through enable  
17 input line 33. On/off amplifier 32 similarly operates to pass the intermediate frequency data  
18 stream received on input path 12 only when an enable signal is applied to the amplifier through  
19 enable input line 34. When an enable signal is not applied to the particular on/off amplifier 31  
20 or 32, the particular amplifier does not pass the respective data stream on to junction amplifier  
21 36. However, when either on/off amplifier 31 or 32 receives an enable signal through its  
22 respective enable line 33 or 34, the data stream on the associated input path is passed on to

1 junction amplifier 36 for input to receiver/signal processor 14 through line 37. Junction  
2 amplifier 36 ensures that the signals are at the correct impedance for input to the receiver/signal  
3 processor 14. As will be discussed in detail below, only one of the on/off amplifiers 31 or 32  
4 is enabled at a given time. Thus only one of the received data streams is applied as an input to  
5 receiver/signal processor 14 at any given time.

6 Receiver/signal processor 14 receives the single data stream from the junction amplifier  
7 36 and produces a desired channel output similar to a direct broadcast satellite television set-top  
8 unit such as an RCA DSS receiver unit or a DVB format receiver unit. The receiver/signal  
9 processor 14 includes a full rate tuner and down converter 40, a demodulator 41, a forward  
10 error correction (FEC) decoder 42, and a demultiplexer/format decoder 45. Each of these  
11 elements is connected to and controlled by a controller 43 which, in the preferred form of the  
12 invention, comprises a suitable processor. ~~When a particular channel or data component is~~  
13 ~~selected by a user through a suitable user input such as the illustrated remote control 44 and~~  
14 ~~remote control signal receiver 46, the controller 43 sends an enable signal to enable the on/off~~  
15 ~~amplifier 31 or 32 associated with the input path carrying the desired data signals thereby~~  
16 selecting the appropriate data stream. The selected data stream is input to receiver/processor  
17 14 and the controller 43 controls the tuner 40 to tune to the particular carrier frequency  
18 containing the <sup>channel</sup> desired data. Tuner 40 then passes this selected carrier frequency to demodulator  
19 41 which demodulates the selected carrier frequency signal to produce signals comprising all  
20 data carried on that particular carrier frequency. This data, which may commonly include data  
21 for several different channel outputs, is passed to FEC decoder 42 which operates under the  
22 control of controller 43 to correct for digital data errors which may have occurred in

*channel required to produce the desired output*

*a*

*a*

1 transmission. The demultiplexer/format decoder 45 then operates under the control of controller  
2 43 to decode the data and separate out the desired <sup>channel</sup> data ~~signals~~ from other data <sup>to produce</sup> for producing the  
3 desired channel output. The selected channel output is directed through output line 48 to the  
4 equipment (not shown) which may utilize the channel output, such as a television set or  
5 computer, for example.

6 A memory device 47 associated with controller 43 stores information required for  
7 controlling the various components of receiver/signal processor 14 and also information for the  
8 switching arrangement 16. The stored information includes a channel identifier unique to a  
9 particular channel <sup>at that point output formed from the channel data</sup> ~~or data component~~ included in one of the data streams received on input paths  
10 11 or 12. For each channel identifier the memory device 47 stores signal path information  
11 identifying which on/off amplifier 31 or 32 to enable for passing the desired data to the  
12 receiver/signal processor 14. For each channel identifier, memory device 47 also stores signal  
13 processing information comprising all control information required by tuner 40, demodulator 41,  
14 FEC decoder 42, and demultiplexer/format decoder 45 in order to produce the desired channel  
15 output. This signal processing information and the manner in which the tuner 40, demodulator  
16 41, FEC decoder 42, and demultiplexer/format decoder 45 operate are well-known in the art and  
17 will not be discussed in detail here.

18 It will be noted that the apparatus 10 illustrated in Figure 1 is shown only for  
19 convenience in describing the invention. Numerous modifications to the illustrated apparatus  
20 10 may be made within the scope of the invention and the following claims. For example,  
21 although two input paths are shown in Figure 1, any number of input paths may be included in

1 an apparatus embodying the principles of invention. Furthermore, the invention is not limited  
2 to any particular radio frequency bands or to any particular intermediate frequency bands.

3 Another important aspect of the invention is that the signals on the two different input  
4 paths 11 and 12 may carry data in entirely different formats such as the DSS, DVB, or MPEG2  
5 formats, for example. As long as the memory device 47 stores the particular signal processing  
6 information for allowing demultiplexer/format decoder 45 to decode the data, there is no limit  
7 as to the particular data format which may be processed by apparatus 10.

8 Another variation from the form of the invention shown in Figure 1 relates to switching  
9 arrangement 16. Although the switching arrangement is shown as being integrated with  
10 receiver/signal processor 14, the switches can comprise any suitable device for selectively  
11 blocking the respective data stream and may be located anywhere in the paths from the  
12 respective receiving antennae 21 and 22 to the junction amplifier 36. These variations in switch  
13 positions should be considered equivalent to the switching arrangement illustrated in Figure 1.  
14 Of course, if the switching arrangement is not controlled by controller 43, some other  
15 arrangement must be included for enabling the desired switch. For example, a simple manual  
16 switch may be used to control the particular switching device and enable the desired data stream  
17 to the pass on to the receiver/signal processor 14.

18 A user selects a particular channel output which may include a television channel or some  
19 other type of data, by providing a select input to the controller 43 through user input device 44.  
20 The controller 43 responds to the select input by accessing the memory device 47 to retrieve the  
21 required operational information. The controller 43 locates the channel identifier corresponding  
22 to the desired channel output identified by the select input and recalls all of the information

1 required to enable the apparatus 10 to process the incoming data to produce the desired channel  
2 output. This information includes signal input information which allows the controller 43 to  
3 enable the appropriate on/off amplifier 31 or 32, and enable only the desired data stream to pass  
4 on to the receiver/signal processor 14. The information retrieved from the memory device 47  
5 also includes signal processing information for controlling the operation of tuner 40, demodulator  
6 41, FEC decoder 42, and demultiplexer/format decoder 45 to process the selected data stream  
7 and produce the desired channel output at output line 48. Since only one signal input path is  
8 enabled at any given time, the multiple data streams do not interfere with each other even if they  
9 include signals at one or more common frequencies.

10 The above described preferred embodiments are intended to illustrate the principles of  
11 the invention, but not to limit the scope of the invention. Various other embodiments and  
12 modifications to these preferred embodiments may be made by those skilled in the art without  
13 departing from the scope of the following claims.  
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